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# JOURNAL

OF THE

MASSACHUSETTS ASSOCIATION

OF

# BOARDS OF HEALTH

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Information for the Public

JULY, 1901

Proceedings of the April Quarterly Meeting

Subjects: The Worcester Isolation Hospital —Sewage Disposal at Worcester.

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# JOURNAL OF THE MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH

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## April Meeting, 1901

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SUBJECTS: Results Accomplished at Worcester Isolation Hospital — The Sewage Disposal Works at Worcester.

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JOURNAL OF THE

# MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH.

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## APRIL MEETING

OF THE

## Massachusetts Association of Boards of Health.

The quarterly meeting of the Association was held at the State Mutual Restaurant, Worcester, on the afternoon of April 25, 1901. In the absence of the President and Vice-Presidents the meeting was called to order by Dr. W. S. Everett, of Hyde Park.

THE CHAIRMAN. — Gentlemen of the Massachusetts Association of Boards of Health, we are very fortunate this afternoon in having with us Mayor O'Connell, of Worcester. We shall be very pleased to hear him address us. Please give your attention to Mayor O'Connell.

### ADDRESS BY MAYOR O'CONNELL OF WORCESTER.

*Mr. Chairman and Gentlemen of the Massachusetts Association of Boards of Health,* — I desire to express to you my appreciation of the compliment done me in inviting me to this dinner to-day, and for the added pleasure of meeting the members of this Association. It gives me great pleasure, on behalf of the city, to extend to you its freedom during your short stay among us.

I don't know that I have anything of particular moment to say to the members of this Association to-day. I am very glad that those

who have had charge of your trip here have seen fit to invite you to two of the most important features of Worcester's municipal life, so far as the health problem is concerned; that is, the isolation hospital and the sewage purification plant. I trust that your visit to the hospital has been a satisfactory one. I know that the hospital, as far as the city is concerned, has given the most satisfactory results. It, however, is an institution about which many of the people of Worcester know comparatively little. Even the members of the city government know little about the isolation hospital, because of the fact that they have no occasion to go there. It is not like the other hospitals, which are open and free to visitors; but most of us in Worcester are more or less hypochondriacs, and we are a little bit afraid of the isolation hospital. Still, we know enough of it to know that it is doing a grand good work among us,— a work that was much needed, and a work that is being appreciated more and more as its advantages are being brought to the knowledge of the citizens of Worcester. As one who is interested in the financiering of the problem, being at the present time the mayor of the city, and formerly having been a member of the Finance Committee of the City Council, it has been a matter of satisfaction to me to know that the institution has been economically managed, and is proving a success. I hope those of you who have not isolation hospitals in your own towns have derived some benefit from your experience there to-day. I think I can safely say, having been interested in the financial management of the institution, that, if you care to know how it is managed financially, we can give you a plenty of valuable information in that feature as well as in the practical management of the hospital.

The sewage purification plant, I understand, you are to visit this afternoon, if the time permits. I sincerely trust and hope that all of you who have the leisure may go there, because I believe you will find in it a very interesting problem. The city has, unfortunately, been compelled, very much against its will, to deal with the sewage question; but we do hope and believe that we are going to find a satisfactory solution of this great problem at our plant in Quinsigamond.

I have been rather interested in talking with the mayor of Lawrence to-day concerning some of the financial situations that confront

the city of Lawrence in regard to the sewage problem and the water problem, and I am rather sorry to learn that we are confronted in Worcester with very much more expensive problems than seems to confront the good city of Lawrence. It was a surprise to me to learn that my good friend, the mayor, is so confident that they have in Lawrence the best water in the Commonwealth. I supposed that we had pretty good water in Worcester, but the mayor assures me that it is not to be compared with the water that comes from the Merrimack River to the good city of Lawrence. Such, he assures me, is the fact, however, and he has promised to send me a sample, and for my own satisfaction has invited me to his city to inspect the filtration system, and also to taste the water.

In Worcester we have been obliged to roll up millions of indebtedness, in order to get an adequate supply of water. The water that we have is of excellent quality, but it has cost the city a great deal of money. Only last year we were obliged to borrow a million dollars to pay over to claimants along the Blackstone River, from Worcester to Providence. Every mill-owner on the stream came up here and demanded satisfaction and damages for a little bit of a tiny stream known as Kettle Brook, that winds its way down the Paxton Hillside. When you stop to think that that little stream has cost us a million dollars, and the city of Lawrence has the good fortune of that great river furnishing water without any expense, you can see something of the financial situation that confronts our city in this respect.

The same thing is true of our sewage purification plant. As I said in the beginning, very much against our will we were forced to tackle this problem of sewage purification; and we have already expended, I believe, something like a million and a half in the separating system and the purification plant. So that you see that Worcester, so far as these two great sanitary questions of water and the treatment of sewage are concerned, is confronted with very serious financial questions.

I don't know, gentlemen, that I have anything further that I would care to say to you, except again to express my pleasure at being with you, and also to commend you for the great interest that you evidently have in your Association. I did not expect, when I arose this morning and found the rain splashing as it has splashed down for

the last twenty-five days or more, that there would be very much of a delegation at this meeting to-day; but it evidently appears that you are not at all terrified by the rain, or perhaps you have not been having it elsewhere as we have had in Worcester. I want to say, in passing, that the mayor of the city is not responsible for the rain in Worcester. There are two gentlemen, however, who are here to-day, who are responsible, and directly responsible, for it. I mean the water registrar, who is a member of the Board of Health, and the city engineer. The city engineer and the water registrar and the water commissioner about a month ago were sorely troubled about the supply of water, and they used to come to my office daily, complaining of the serious situation that confronted us; and so the three of them got to praying, and they kept up praying for about two or three weeks, and this is the result. [Laughter.] I might say, in conclusion, that, if you are ever confronted in your home cities with any serious problems, such as a shortage of water, or the breaking out of cholera or typhoid fever or any other epidemic, you can call on our water registrar and city engineer and water commissioner; and I think they will be able to save you from any great danger. [Applause.]

THE CHAIRMAN.—We are happy in having with us to-day Mayor Leonard, of Lawrence. We would be pleased to hear him address us.

MAYOR LEONARD, of Lawrence.— Mr. Chairman and gentlemen of the Massachusetts Association of Boards of Health, I cannot welcome you to Worcester, as Mayor O'Connell has; but I can thank you for the privileges accorded to me by the board of my own city, and also by the boards of all other cities, to be present at this little outing or annual inspection, whatever you may call it.

Of course, gentlemen, I am very pleased to meet the Massachusetts Association of Boards of Health. In the first place, I had a different impression, a different opinion altogether, about what constituted the Boards of Health, what kind of looking men they were. I have been reading some of the late inaugurals regarding the members of the Boards of Health; and I can assure you that I am very happily disappointed in meeting some of them — in fact, all of them — to-day,

including those from Salem. [Laughter.] I was more than surprised, gentlemen, in finding that the members could get along here to-day without their coachman that we have heard so much about. Consequently, I can not only compliment Salem on the intelligent appearance of its board, but every member present, I presume. I think every city that is represented here can be congratulated on its selection of members of the Board of Health.

Mayor O'Connell has told you, of course, that the water up in Lawrence is very good, etc.; and he has not told you anything but what is practically true, gentlemen. We take the water from the Merrimack River after Lowell and Manchester and Nashua and all other cities get good and through with it,— after they get through with everything they might see fit to do with or in it, etc. When they get good and through with it, we simply drink it, gentlemen, — after we get through bathing in it. Furthermore, I want to impress upon you the fact — and some time I would be very pleased to have the members of this board visit Lawrence, and prove to them and convince them of it — that there is not any city in the State that has any purer water than the city of Lawrence, notwithstanding the fact that we use it after all other cities on the line of the stream get through using it.

Now, gentlemen, you will please excuse me for interrupting your programme to-day. I did not intend to say a word. I am simply a passenger here. I am here as a matter of courtesy. I am brought here for a purpose. We have a Board of Health, gentlemen, of the city of Lawrence, — of course, you are aware of the fact that we have a Board of Health in the city of Lawrence, because they are here amongst you this afternoon,— and I am tired of hearing about this hospital and that hospital. Everything that is good the city of Lawrence has got. They kept impressing upon me the fact that the city of Worcester had a hospital, not only such as the city of Lawrence wanted, but something that the city of Lawrence wanted to improve upon; and we are not going to have a hospital equal to the one that you saw to-day, we are going to have a much better one. [Laughter.] It is very nice, gentlemen. As a matter of courtesy, I would like to be very complimentary to the mayor, and to the city of Worcester, etc., because they have used us very kindly; but I presume that I have got the same ambition that every member present has. Every one

that has not got a hospital of the kind and character that we visited to-day is very anxious and very desirous of having something of the kind. You all know the need and the necessity of such institutions. Consequently, it is not necessary for me to say a word on that question.

Nor is it necessary for me to say anything regarding your duties as members of the Board of Health. Up in the city of Lawrence we trust our affairs regarding health matters entirely to our board. We have an able and efficient board, and they are well able to take care of all matters of this kind. Consequently, for fear that I might make mistakes regarding matters that will concern you and upon which you will talk this afternoon, the safest way for me is simply not to refer to them at all. However, gentlemen, some time I hope to have the pleasure, following the example of the Mayor of Worcester, of extending to you a welcome in the city of Lawrence. We shall be glad to meet you there and glad to use you well. Before I retire, and without taking up any more of your time, I desire to thank you, one and all, for the courtesy you have shown to me and to the members from the city of Lawrence, and hope some day that we may be able to return it. [Applause.]

THE CHAIRMAN.— We will now listen to the reading of the records of the last meeting by the Secretary.

On motion of Dr. H. W. Hill the records were taken as read.

THE CHAIRMAN.— The Executive Committee have reported for membership in this society the following names: Fred R. Houghton, of Fitchburg, a member of the Board of Health; Dr. A. O. Hitchcock, of Fitchburg; Dr. Charles F. Stack, of Hyde Park; Dr. Charles R. Marble, of Hingham; and Charles Sedgwick Minot, of Milton.

The gentlemen named were elected to membership in the Association.

The next business to come before you will be the reading of the paper on "Results Accomplished at the Worcester Isolation Hospital," by Dr. May S. Holmes, superintendent and resident physician.

# RESULTS ACCOMPLISHED AT WORCESTER ISOLATION HOSPITAL.

BY DR. MAY SALONA HOLMES, SUPERINTENDENT AND RESIDENT PHYSICIAN.

It is unfortunate that certain infectious diseases are the unwelcome but ever-present guests of all organized communities to-day. Therefore, it has become the duty of the board of health of these communities to provide for their isolation. If there could be thorough co-operation of the citizens with the boards of health to this end, no doubt these diseases could be wiped out of existence in a comparatively short time. It is needless to say, however, that we cannot hope for this happy result until the millennium comes; for it is inevitable that many mild and atypical cases will not be recognized, that many will be wilfully concealed, and that, owing to the popular prejudice to hospitals of this kind, commonly called pest-houses, many more will refuse the isolation provided. There has been in recent years considerable progress made by the municipal control of infectious diseases, which must inevitably have had its effect upon their spread. Owing to this recognition of the constant menace to life from disease in its cities, the Massachusetts legislature in June, 1894, passed the following act: —

SECTION 1. In any city in which no suitable hospital accommodations have been provided for the care and treatment of persons suffering from contagious diseases dangerous to the public health, the board of health of such city may address a communication to the mayor thereof, stating that, in the opinion of said board, the safety of the inhabitants of the city demands that suitable hospital accommodations should be provided for the reception and treatment of persons suffering from such diseases other than small-pox and those of a venereal nature. The mayor shall forthwith transmit such communication to the city council; and the city council shall forthwith order such hospital accommodations to be provided, and shall make the necessary appropriations therefor.

SECT. 2. Every city in which hospital accommodations have been

provided in accordance with the provisions of this act shall make an annual appropriation for the maintenance of such hospital accommodations; and said appropriations shall be expended under the direction of the board of health unless otherwise ordered by the city government.

In accordance with this act the Board of Health of Worcester sent to the Mayor of this city in January, 1895, a request that early provision be made for such a hospital. An appropriation of $30,000 was accordingly set aside, the plans submitted, and the erection of the hospital begun that same year. The site obtained for the hospital was a most fortunate one. Few cities are able to furnish a location so admirable in such a variety of ways. The distance from the centre of the city is not great; and yet it is practically in the country, with an apple orchard in front and woods in the rear. There is plenty of land to cultivate for garden supplies. The patients have playground space a sufficiently safe distance from neighbors. The buildings are on the slope of a hill of good elevation with a southern exposure. Sunlight and the circulation of fresh air are unobstructed. The plans of the buildings were made by Fuller, Delano & Frost of this city. There are four separate buildings arranged in a hollow square. The appropriation did not permit of making preparation for but two diseases. Scarlet fever and diphtheria were, therefore, selected as the two most common and most malignant of the infectious diseases, and hence the greatest menace to the welfare of the city.

There has been really great demand made upon us to isolate measles also; but the city government has not been able as yet to add to our appropriation a sufficient amount for that purpose.

The hospital, as at first erected, consists of an administration building. Forty feet to each side of this and somewhat to the rear are the ward buildings, the one on the east for diphtheria, and the one on the west for scarlet fever. These three buildings are connected by both over and under ground corridors. In the rear is a separate building, in which are the ward laundry, the sterilizing plant, a morgue, and chapel. The wards are exactly alike in plan. Each provides 2 rooms which can accommodate from 12 to 16 patients, 3 private rooms, and a nurse's serving kitchen. There are closets

and bath-rooms at the extreme ends of each ward building, separated from them by cross corridors for ventilation.

With 6 beds in each ward, 80 cubic feet of fresh air per patient per minute is provided. The heating is by indirect radiation. In addition there are windows on opposite sides of the wards for cross ventilation, and there are fireplaces. 15 patients can thus be comfortably cared for in each building. A few more even may be easily added, provided they will accommodate us in their division as to age, sex, and degree of sickness. For the past year the average number daily in the hospital has been 25, to be divided between the 2 diseases. Our largest number at any one time was 45, 31 of whom had to be stowed away in the scarlet fever building. That was not comfortable, however. The basements are cemented throughout. Robing-rooms are provided in them, where nurses change their outer clothing on entering and leaving the wards, and where the attending physicians and necessary visitors don robes and caps. The work of the hospital increased so rapidly that the administration building has already had to be remodelled and enlarged to provide for more nurses and for their better accommodation. More cold storage room and a larger heating plant were also added. We have also bought an adjoining cottage with additional land at a cost of $3,500. The cottage enables us to provide for our janitor's family, and to separate the nurses in the scarlet fever wards from those in the diphtheria. We had never been able in any way to suspect any mixing of infection by the intermingling of our nurses; but, as the hospital grew, the danger increased, and we were much pleased when we were able to separate them. We have not yet been able to trace a case of infection to any of the employees. Although the buildings are so thoroughly separate in their entire equipment, the patients themselves are not always accommodating, but will persist occasionally in having more than one infectious disease at the same time. To place such patients where they will do no harm to others taxes our equipment exceedingly, especially in the winter months when we are crowded. We do feel a very urgent need for a separate building for mixed infections, and hope that its realization is not far distant. Otherwise the plan of the hospital has proved to be very practical and, in the main, satisfactory. This separate cottage plan is one

we would always heartily recommend. The entire cost of the hospital plant, including seven acres of land, and the additions has been $50,000. The average net cost per year for maintenance has been $6,849.

As the work of the hospital has increased, the administrative force has grown in proportion until now it consists of a superintendent and resident physician, a housekeeper and a superintendent of nurses. There is an attending staff of four physicians and a pathologist. The entire question of obtaining nurses has throughout been a serious one. We hope, however, that our latest plan, even though a bold one, of instituting our own training school, will solve the problem. At first we depended upon the City Hospital, and a course in contagious diseases was made a part of the curriculum of their school. It became impossible for them, as time went on, to furnish a sufficient number; and we were obliged to hire nurses from other sources. The supply available was limited, however; and we were frequently at a loss to obtain enough who were sufficiently capable to carry on the work satisfactorily. We were therefore driven to the last resource of training our own nurses, and have so far been encouraged in our undertaking by the results. We expect to supplement the course in our own hospital by work elsewhere in surgery and obstetrics before awarding any diploma. We are also able to continue the training of the City Hospital nurses and to admit a limited number of post-graduates from out-of-town hospitals for a four months' course. The number of these applicants is steadily increasing as the hospital becomes better known. The fear of contracting the diseases has had its influence more or less upon the peace of mind of the nurses. A certain proportion, perhaps half, have been immunized with diphtheria antitoxin. No one of these contracted the disease under six weeks' time. The rashes have been rather disagreeable in some cases, and we have therefore ceased to urge immunization. Should a nurse contract the disease, we have no fear of being unable to control it with the help of antitoxin. Since the opening of the hospital, ninety-seven different nurses have been employed. Of this number, four contracted diphtheria, four scarlet fever, and one whooping-cough. This makes the percentage for each of the two diseases 4.12 per cent. of the number employed, and for all diseases 9.2 per

cent. No other employees in any capacity have contracted disease with the exception of the superintendent, who had each in turn, and one member of the staff, who contracted diphtheria. Even ward maids and laundry girls have so far been exempt.

Owing to the limited capacity of the hospital, the administration has been obliged to make rather rigid rules for the admission of patients, especially on the diphtheria side. No case of diphtheria is admitted until the bacteriological report supports the diagnosis, except in laryngeal cases. This rule has not always been approved by the profession; but we have felt that, taking into consideration our limited capacity, it was best, for all concerned, to adhere to it. With the help of antitoxin there are few cases which cannot wait the few hours necessary for the report, which at most is only twenty-four and, in cases of special urgency, can be reduced to six. The swab even can be examined at once, under certain conditions. The repeated admission of patients suffering from tonsillitis of non-dipththeritic origin can be thus avoided. We have no place to separate them from the diphtheria patients; and, even though antitoxin renders them immune, they have to submit to the sterilization of their clothing and to the other disagreeable features necessarily attending isolation. Antitoxin has been most generously supplied by the State Board of Health, and is kept constantly on hand for distribution by the local board. The hospital has also had the benefit of this generosity on the part of the State Board, and we wish to publicly express our gratitude to them for it. We feel sure that by its unstinted use we have not only saved lives, but have been able to swell the statistical records in its behalf. Diphtheria patients are not discharged until two consecutive negative cultures have been obtained. We do not possess the same degree of scientific knowledge about the infectious period of scarlet fever, but no patient is discharged until the skin is absolutely smooth. No visitors are admitted to see the patients, except where there are indications of a fatal termination of the disease. Then only the adult members of the immediate family are admitted, together with the spiritual adviser and such others as are absolutely necessary. Professional courtesy is always shown physicians.

As to our sterilizing plant: — the steam sterilizer which was made

for us by the Stewart Boiler Works has been very satisfactory. It consists of a jacketed cylinder large enough to admit mattresses. A brick partition crosses it in the middle, so that the infected material can be put in at one end and taken out of the other. By never opening both ends at the same time there is no communication between the infected and clean rooms. All materials that can be disinfected by the ordinary boiling in the laundry are done in that way. Blankets, mattresses and, until recently, the patients' clothing were disinfected by the steam. We now use formaldehyde, when practicable. Steam under pressure necessarily affects the materials submitted to it to a certain extent. Cloth will shrink, stains will be set, and the peculiar odor of heated wool will be left. Our sterilizer is a good one, however; and we think these disadvantages are reduced to a minimum.

The hospital opened to admit patients Nov. 25, 1896; and from that date until the end of the year 11 patients were admitted. 7 of them had diphtheria, 2 had scarlet fever, and 2 did not have either disease. In spite of our vigilance, patients occasionally get in who do not have either diphtheria or scarlet fever. Eruptions are often thought to be those of scarlet fever which later prove to be due to some other cause, and sometimes patients are unceremoniously dropped at our doors who do not belong there. In 1897 there were 92 patients. That was our first complete year. In 1898 there were 99 patients; in 1899, 203; and, in 1900, 338. During the first year, 1897, there were 70 cases of diphtheria treated, which was 20.8 per cent. of the cases reported in the city. The next year 23.9 per cent. came in. In 1899, 29.7 per cent. entered, and in 1900 38.3 per cent. Of scarlet fever cases the first year we received 7 per cent.; of the cases in 1898, 9.7 per cent.; in 1899, 17.7 per cent.; and, in 1900, 27.2 per cent.

You will observe from these figures that not only have the actual numbers treated at the hospital increased year by year, but the proportion of cases has increased also. In this city, as well as elsewhere, the mortality rate for diphtheria has been decreasing in recent years. This is due principally to the routine bacteriological examination of all sore throats, to the increasing popularity of antitoxin among physicians in private practice, and to the hospital. There

were 6 deaths from diphtheria the first year in the hospital, making the mortality rate 8.57 ; while the death-rate for the city that year was 17.62. Excluding the cases treated at the hospital, the rate was 20.24. Therefore, the hospital lowered the city's mortality by 2.62. In the same way we find that the city's rate was lowered in 1898 by .85 ; in 1899, by 1.17 ; and, in 1900, by .77,— and that, too, in spite of the fact that most of the septic cases came to the hospital, as well as a large proportion of those requiring operation.

Since the opening there have been 479 cases of diphtheria treated, with 38 deaths, giving a mortality rate for the whole time of 7.93. The same good results were obtained, also, on the scarlet fever side. During the first two years there were no deaths from scarlet fever in the hospital. I would say here that the Board of Health has never yet compelled a case to enter the hospital. The hospital treatment is rather offered to them as a privilege; and their acceptance has been purely voluntary, as far as the board has been concerned. Limited capacity has been one cause for this stand. Also, it was thought that the hospital would gain more patients in the end, would obtain the public confidence by its good reputation, and that the idea of it being a pest-house, where all sorts of horrible, loathsome diseases are supposed to be huddled together, would gradually disappear. You can infer from the figures how successful this has been. The benefits derived from such a hospital are far greater, however, than are shown by simple mortality statistics. In fact, the most important ones are negative in visible results. By the complete isolation afforded these cases of infectious diseases there is no question but that epidemics have been aborted.

There are in Worcester, besides the public schools, many private institutions where large numbers of young adults are brought into close contact. There have been in the past four years repeated outbreaks of infectious diseases in these places. These have occurred especially in the private schools. Scarcely one has escaped, but by the immediate removal to the hospital of the cases as they appeared the spreading of the disease was prevented. Not one of the institutions had to be closed. The appearance of these outbreaks in schools is acknowledged to be inevitable, but the facility offered by the city for the control of the same is sure to be appreciated by the

patrons of these schools. Therefore, their reputation is enhanced and indirectly that of the city, also. Then, too, there are adults constantly being admitted from the boarding-houses and hotels, from factories and stores. Servants in private families are not exempt. By these the privileges of the hospital are even still more appreciated. Another important step gained by such a hospital is the advance which can be made by the properly directed study of these diseases in a suitable environment. The actual value of any particular method of treatment can be better determined in a hospital where the patients are constantly watched by trained observers, and where the officious interference of well-meaning friends and the other ill-effects of home environment can be eliminated. Physicians, therefore, look to the hospitals for practical results of scientific research and discovery. The wide-spread use of antitoxin to-day is a striking example, and this hospital has done its share toward proving its life-saving powers.

Such, then, is the Isolation Hospital,— its administration and the results as we are able to judge of them at the end of four years. We feel that the city government has the right to consider its money well appropriated, and that we can heartily encourage other cities, which have not already established such a hospital, to follow our example.

THE CHAIRMAN.— The next business before the meeting will be a note on "Apparent Diphtheria Infection from Well Persons Carrying Diphtheria Bacilli," by Dr. F. W. White, of Boston.

DR. HILL.— Dr. White is not present, and has asked me to read his paper; but on account of the short time that we have I think just to read it by title will be sufficient, if you are willing.

THE CHAIRMAN.— We shall understand that we are to have it at another meeting?

DR. HILL.— Yes, sir.

THE CHAIRMAN.— The next thing in order will be the reading of a paper entitled "Description of Sewage Plant and Methods of Sewage Purification used at Worcester," by Professor L. P. Kinnicutt, of the Worcester Polytechnic Institute.

# THE SEWAGE DISPOSAL WORKS AT WORCESTER, MASSACHUSETTS.

## WITH A BRIEF NOTICE OF CERTAIN EXPERIMENTS MADE BY HARRISON P. EDDY AND LEONARD P. KINNICUTT.

*Mr. President and Gentlemen,*— On October 15, 1890, a little over ten years ago, I had the pleasure of addressing this Association at a meeting in this city, taking as my subject "Sewage and Sewage Disposal," with a description of the Worcester Sewage Plant. To-day I again have the pleasure of addressing the Association at its meeting in this city, and take the liberty to again address you on the same subject, giving, also, a very brief outline of certain experiments which have been made by Mr. Eddy and myself on the action of septic tanks on Worcester sewage.

In my talk to you ten years ago I described quite fully the three processes that at that time had been tried successfully on a large scale; namely, sewage farming or broad irrigation, chemical precipitation, and intermittent downward filtration. The last of these methods was then in a more or less experimental stage; but the statements that I made at that time — namely: "This method has received most careful consideration from sanitary engineers; and it is with this method that extended experiments have been made by the Massachusetts State Board of Health at Lawrence. Their report on the subject is now in press; and, therefore, the time has not come to discuss it at any length. From what I know of the work, I believe their experiments will show that domestic sewage — sewage that does not contain refuse from manufactories — can be sufficiently purified so as to enter a river not used as a water supply, by intermittent downward filtration through carefully prepared beds of sand"— have been more than justified, and the modern methods of sewage purification are bacterial methods; and that this is the case is due, to a very great extent, to the excellent work of the Massachusetts State Board of Health.

Regarding the other two methods that I then mentioned, sewage

farming and chemical treatment, what I said regarding the first, sewage farming, I still believe to be true: "that this method of purification cannot be recommended, except in very rare cases, on account of the character and the amount of land required."

What I said, however, in regard to chemical precipitation has not stood so well the test of time as my other statements; and I would not to-day state that chemical treatment as then understood is the most satisfactory way for the purification of sewage containing large amounts of free acid and mineral waste. Yet, after ten years of study of this question, and a rather intimate knowledge of what has been attempted both in America and Europe, I am not able to-day to say to the authorities of a city whose sewage is of a decided acid character that there is any method which, at an allowable cost, will surely give satisfactory results.

As I said a moment ago, the modern methods of sewage treatment are all bacterial,— that is, depending on the action of micro-organisms for breaking up and decomposing the putrefiable matter in the sewage; and the question that is at the present time receiving the most consideration from sanitary engineers is how to provide the most favorable condition for the action of these micro-organisms. It is now known that the decomposition of the animal and vegetable matter in sewage takes place in two stages, known as the putrefactive and nitrifactive stages. The first is brought about by bacteria that live in the absence of air, the anærobic bacteria. They break up the more complex substances, and bring them into a condition where bacteria which must have air to exist, the ærobic bacteria, decompose them into harmless gases,— hydrogen, marsh gas, nitrogen, ammonia, carbon dioxide,— and cause the oxygen in the air to unite with part of the nitrogen to form mineral substances known as nitrates. The more modern methods try to bring about conditions which will admit of these two processes taking place separately, and have devised tanks known as septic tanks, or resolving chambers, in which the first action takes place, and double contact beds, in the first of which beds the action, to a greater or less extent, is the putrefactive or anærobic action, and in the second the nitrifying; and we now, besides the intermittent filtration process, talk about the septic tank treatment and the double or triple contact system.

The septic tank process I described to you at the meeting held in Boston last July, and to-day I can show you in operation a rather large open septic tank and a small experimental closed tank. At this time I will only say that the septic tank treatment is a preliminary treatment,— a treatment which does not, by any means, purify the sewage, but a treatment which takes out a large amount of solid matter and renders the sewage more easily acted upon by the bacteria that live in the presence of air; in other words, prepares the sewage for treatment by intermittent filtration or by the contact system.

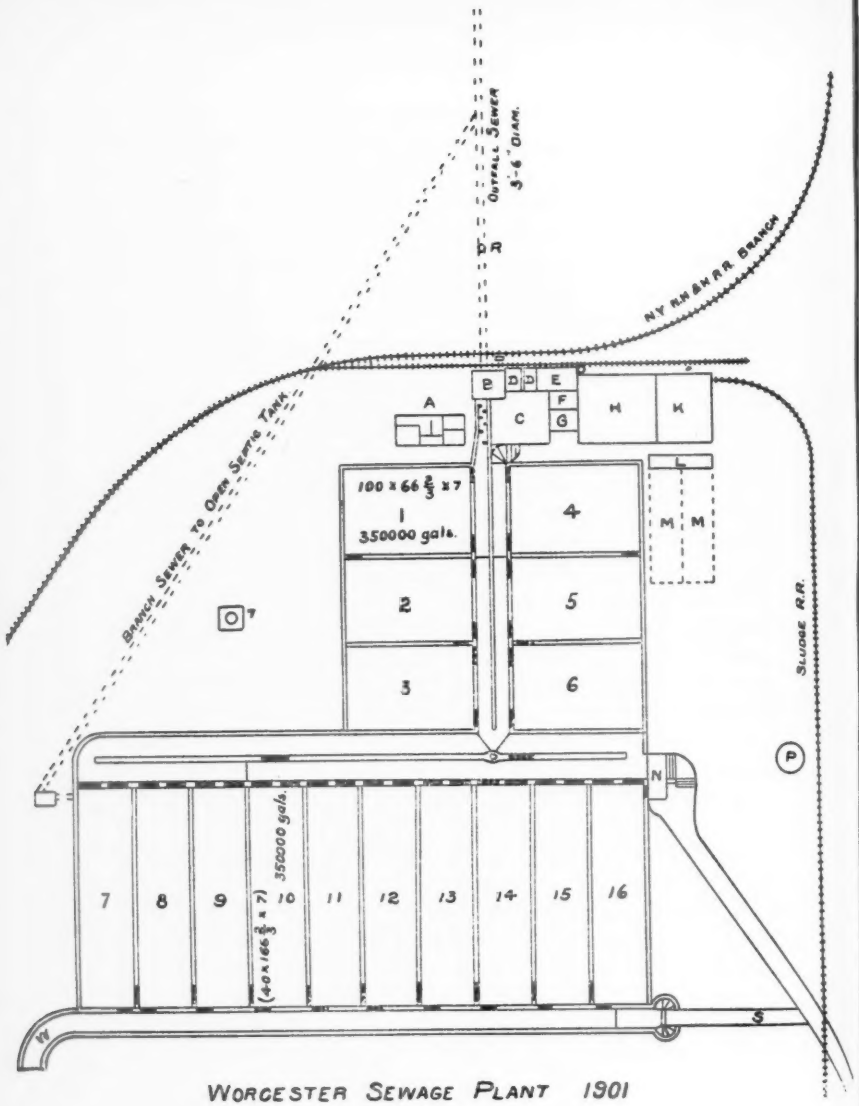
The contact method of treatment is a device to bring about on a small area the same results as those brought about by intermittent filtration on a much larger area. It differs from the intermittent filtration in using entirely artificially made beds filled with a rather coarse, hard, granular material, and filling the bed with sewage, allowing it to remain full a certain number of hours and then quickly drawing off the purified sewage; while in the intermittent filtration method the sewage is allowed to filter slowly through a natural but underdrained bed of sand a certain number of hours each day. The results obtained by the contact method are not as good as those obtained by intermittent filtration; but the method, when properly managed, gives a product which is not putrescible and, consequently, does not cause a nuisance when allowed to enter a small watercourse.

Having thus briefly given an outline of the methods of sewage treatment, I will devote the remainder of the time to outlining the work that is being done and the experiments that are being made at the Worcester Sewage Disposal Station.

Worcester sewage, as it comes to the plant, is a sewage containing free acid, iron salts, wool washings, tannery waste, dyestuffs, etc., besides the substances ordinarily found in the sewage of a residential town.

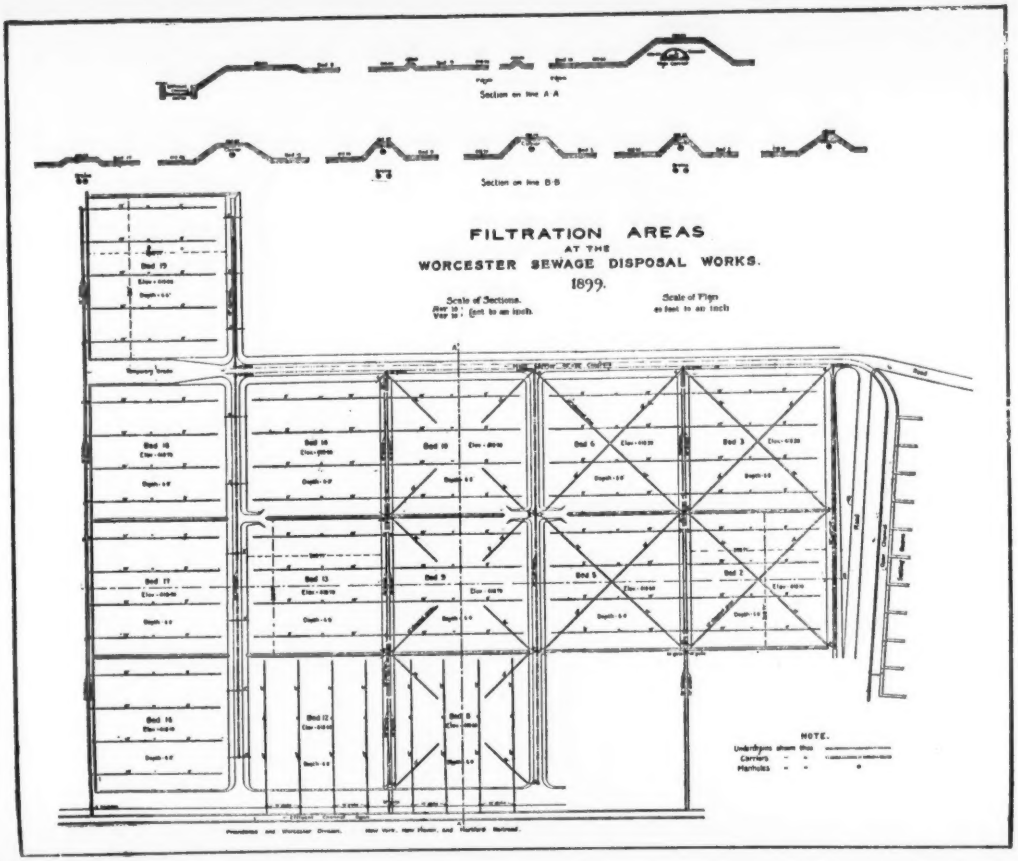
When it reaches the works, it is made alkaline by the addition of lime, about 7 grains of quick-lime now being added, on the average, to a gallon of the sewage. The amount added varies greatly. With sewage which contains a large amount of tannery waste and dyestuffs, much less lime being used than with sewage that is less colored and containing more free acid and iron salts.

Diagrams 1 and 2 give the ground plan of the disposal works, and I will make use of them in describing the methods used.



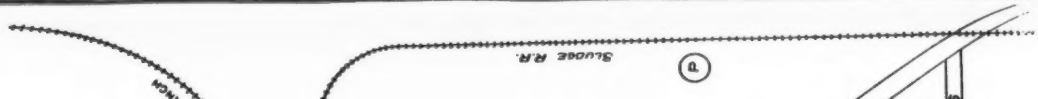

WORCESTER SEWAGE PLANT 1901

DIAGRAM 1




WORCESTER SEWAGE PLANT

DIAGRAM 2



When the sewage contains tannery refuse, which is about seven hours each day, the lime is run from the lime-house back to point R, where it enters the sewer. The sewage containing the lime runs down the channel, and is divided into two portions, one-half running into tanks 2 and 3, the other half into tanks 4, 5, and 6. The sewage is then united again into one portion, and half goes through tank 8 and half goes through tank 9, and then on to the filter beds, thirteen in all, filter bed 8 being reserved for the effluent from the open septic tank. From the filter beds the effluent runs into the Blackstone River. The amount of lime added equals about 4 grains per gallon.

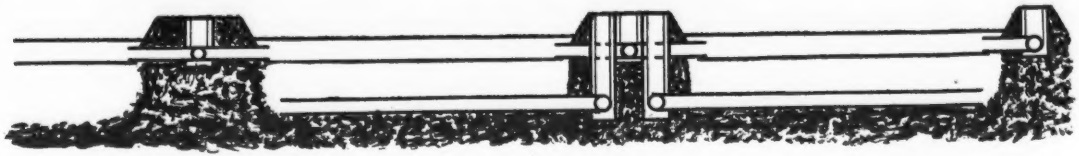
The filter beds are of an acre superficial area, and each bed receives 500,000 gallons every other day.

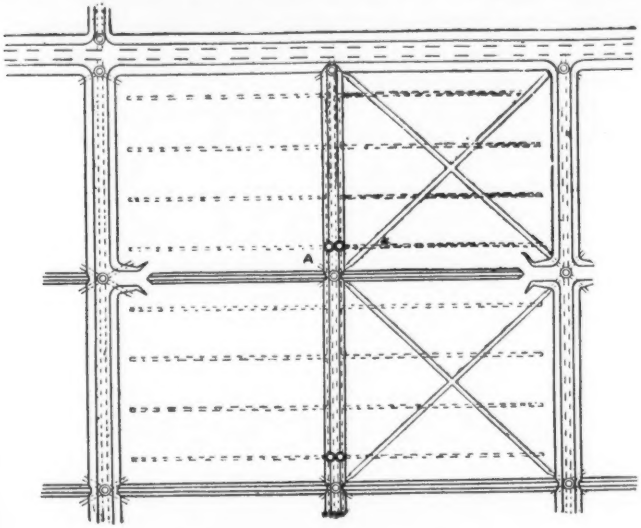
When the sewage is comparatively free from tannery waste, after receiving the lime, 9 grains per gallon, it is carried down the channel to basins 10 to 16, each basin receiving an equal amount. The effluent from these basins runs directly into the river.

As to the filter beds, diagram 2 shows their general construction.

Diagram 3 gives a section and ground plan of four of the sixteen intermittent filtration beds of the sewage plant at Worcester, Mass., and also a diagram showing the valves controlling the flow in the feed pipes and in the drains.

The beds are of coarse sand, from which all pockets of clay and quicksand have been removed. They are each of about one acre superficial area, and are divided from each other by dikes, those containing the feed and drain pipes being raised six feet above the level of the beds, while those running at right angles to these are only eighteen inches high. In order that certain of these beds should be fairly water-tight, the dikes surrounding them are lined with tamped clay. The drains of Akron pipe, laid with open joints, are six feet below the surface of the bed, and are fifty feet apart, the outer ones being twenty-five feet from the edge of the bed. The first hundred feet of pipe in each bed is 10-inch pipe, the remainder is 8-inch. The drains connect with two 24-inch pipes, placed in the dikes between the beds; and by the aid of valves the drainage of each bed can be separately collected, in order that the exact action of the bed can be tested.





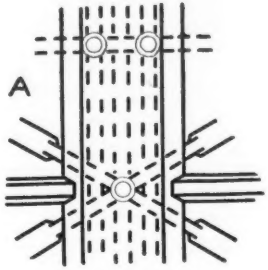




DIAGRAM 3

INTERMITTENT

FILTRATION BEDS

The feed pipes are eight inches in diameter and are connected with split pipes, which in four of the beds extend across the entire distance of the bed, in order to give an even flow over the whole surface of the bed; and the flow upon the bed is regulated by molasses gates placed in the manholes at the four corners of each bed.

The following table shows what has been accomplished at the Worcester Sewage Plant during the past year by the chemical precipitation process. The results are averages of daily analyses: —

FOR THE YEAR 1900.

| | | Ammonia. | | | | |
|---|---|---|---|---|---|---|
| | *Free.* | *Albuminoid.* | | | *Oxygen Consumed.* | |
| | | *Total.* | *Dissolved.* | *Suspended.* | *Total.* | *Filtered.* |
| Sewage | 1.097 | 0.480 | 0.237 | 0.243 | 5.63 | 3.24 |
| Effluent | 0.988 | 0.222 | 0.211 | 0.011 | 2.71 | 2.71 |
| Per cent. removed | 9.93 | 53.73 | 10.97 | 95.53 | 51.73 | 16.36 |

Judging from the albuminoid, ammonia, and oxygen consumed, a purification of a little over 50 per cent. has taken place. This result is as good as can be obtained by the chemical treatment of a sewage, that process doing very little more than removing the suspended putrescible substances.

As to the purification of the effluent from the chemical precipitation process by the intermittent filtration beds, the albuminoid ammonia is reduced to 0.07 parts in 100,000 parts, and the amount of nitrogen as nitrates formed equals about 0.75 parts in 100,000.

The disposal of the sludge, the insoluble matter thrown down by the chemicals used, is the most difficult problem connected with the process of chemical treatment. The idea that it will be bought or taken as a gift to any extent by farmers has at last been abandoned. At Worcester it is treated as follows: From the tanks it flows by gravity to a well at the point P, diagram 1, from which it is raised by an ejector to the sludge tanks MM., passed into the screen house L, and, after being mixed with lime, is pumped into the presses. The expressed liquor is carried to a special filter bed, not shown on the plan. The pressed cakes are dropped into open cars and carried by the sludge trolley railroad about a mile below the works, and dumped into a deep valley, which in this way is being gradually filled up.

About 5,000 gallons of sludge, containing 93 per cent. water, is

formed from each million gallons of sewage treated; and about 20 pounds of lime are added to each 1,000 gallons of this sludge before it is pressed. After pressing, the sludge contains from 70 to 75 per cent. water; and the amount equals about 6 tons for every million gallons of sewage treated. The sludge, dried at 100 degrees Centigrade, contains 40 per cent. of organic or volatile matter.

During the past year Mr. Harrison P. Eddy, the superintendent of sewers, and I have been studying the action of septic tanks on acid, iron sewage; and, though we are not as yet prepared to publish the results, the following notes may be of interest: —

Tank No. 7, diagram 1, holding 350,000 gallons, has, since the first of last June, been used as an open septic tank. The flow through this tank has been regulated so that 300,000 gallons of crude sewage, taken, as shown on the plan, from a point above where the lime is added to the sewage, flow through this tank in 24 hours; and from July 1, 1900, to April 1, 1901, about 82 million gallons of sewage have passed through the tank. One month after the sewage had passed through the tank a scum began to form, which increased in thickness until it was about $\frac{1}{2}$ inch thick. During a violent windstorm in September this coating was blown off the tank, and has never re-formed; but action has gone on in the tank, as shown by the gas being continually given off, and by the analyses of the gas and of the liquid as it passes from the tank.

The formation of a thick coating on top of the liquid in a septic tank seems to depend somewhat on the character of the sewage. At Leeds, Manchester, Huddesfield, the open septic tanks are covered with a thick crust; while, according to Mr. Cairns (Report of Sewerage Commission of Connecticut, 1901, page 49), at Birmingham there is no crust or thick scum on the surface of the liquid.

The action of the septic process on Worcester sewage is shown by the following results, which are the averages of analyses of daily samples from July 1, 1900, to April 1, 1901: —

| | | *Ammonia* | | *Oxygen* |
|---|---|---|---|---|
| | *Total solids.* | *Free.* | *Albuminoid.* | *Consumed.* |
| Crude sewage . . . . . | 75 | 1.726 | 0.690 | 9.04 |
| Effluent from tank . . . | 50 | 2.229 | 0.496 | 7.05 |

33 per cent. of the total solid matter has been removed, equalling

25 parts in 100,000 parts, or 14.64 grains per gallon. The total solid matter removed from the sewage during the nine months is therefore 82 million times 14.64 grains, or 85 tons.

The bottom of the tank has never been cleaned out, and from measurements made last Tuesday the average depth of the sludge, or deposit, at the bottom of the tank seems to be about 10 inches, which makes a deposit equalling 5,533 cubic feet. One cubic foot of this deposit contains about 5 pounds of solid matter. 5,533 cubic feet would therefore contain about 14 tons. Deducting this amount from 85 tons, we have over 70 tons of solid matter that has been liquefied or changed into gases.

The amount of purification that has been brought about by the septic action (judged from the albuminoid ammonia) is 29.1 per cent.

The results obtained with Worcester sewage by septic action in an open tank are not as satisfactory as have been obtained in the great majority of cases where the septic process has been tried; and this can be explained, I believe, by the acid iron character of the sewage, the amount of iron sulphate and free acid each equalling about 10 parts in 100,000 parts.

The effluent from the open septic tank has been run on to bed 8, diagram 2; but I cannot at this time give exact figures showing the amount of purification that has been brought about by the bacteria in this bed, but can say that, though there has been very little nitrification, the albuminoid ammonia has been reduced, so that the effluent from the bed contains only 0.1 part albuminoid ammonia in 100,000.

Very careful experiments have also been made by Mr. Eddy and me on the action of a closed septic tank on acid iron sewage, the results of which we hope soon to publish. The general action of the tank has been similar to that of the open tank.

One result, which I believe is new, I can mention at this time; and that is regarding the change that takes place with the iron sulphate in the sewage. The iron sulphate is reduced to iron sulphide; and the iron sulphide thus formed is in a very fine state of subdivision, so that a comparatively large amount is carried off in the effluent. It is due to this fact that the effluent is of so dark a color, and that a greater amount of solid matter is not removed by the septic action in iron acid sewage.

When this insoluble iron sulphide which is in the effluent is allowed to settle and is dried at the temperature of the air, it is changed into ferric oxide and free sulphur. This is what might be expected, as it is the change that takes place with pure iron sulphide; yet, as far as I know, it has never been noted in experiments on sewage purification. What effect free sulphur has on the bacteria contained in the sand filters is a question we are now studying.

There is only one other result that I will mention at this time, and that is regarding the gases given off from the septic tank. The amount varied very greatly. In October it was about $3\frac{9}{10}$ cubic feet for every 1,000 gallons treated, while the amount during December did not average over $1\frac{3}{10}$ cubic feet per 1,000 gallons. The gas had a decided odor, but did not contain sulphide of hydrogen, and was a mixture of carbon dioxide, marsh gas, nitrogen, oxygen, containing only in comparatively few cases any amount of hydrogen. The gas seemed also to contain small quantities of another substance, varying from 0.1 to 0.6 per cent.; and this substance, in certain analyses of septic tank gases that have recently been published, is stated to be carbon monoxide. (Thirty-first Annual Report, State Board of Health of Massachusetts, page 422.) In over two hundred analyses we have made of the gases given off from the septic tank, we have obtained, in the great majority of cases, small amounts of this substance; but we feel quite positive in stating that it is not carbon monoxide, for, while it is absorbed by cuprous chloride, it gives neither the hæmoglobin nor the iodine pentaoxide reaction. We hope later to be able to show what the substance is.

I have already occupied too much of your time, and must defer giving any more details regarding the experiments that have been made, which, however, will be published in full in the near future. I only hope that I have at this time given you a sufficient idea of what is being done at the Worcester Sewage Disposal Plant to make your inspection of the works one of some interest.

THE CHAIRMAN.— Owing to the lateness of the hour, it seems desirable that discussion of these papers should be postponed until another meeting of the society.

MR. SCOTT.— Mr. Chairman, I move that a vote of thanks be extended to the speakers of the day.

The motion was adopted, and the Association then adjourned.

(*Continued from page ii.*)

**Hyde Park.**
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Edwin C. Farwell.
William W. Scott.

**Lancaster.**
Allen G. Butterick.
H. M. Nash, M.D.
F. A. Willard.

**Lawrence.**
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F. W. Kennedy, M.D.
Fred H. Schaake, M.D.
George W. Smith.
Emil C. Stiegler.
J. F. Winchester, M.D.

**Leominster.**
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H. N. Spring.
A. L. Whitney.

**Lexington.**
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C. Minot Weld.

**Needham.**
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A. M. Miller, M.D.

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W. S. Kirschbaum.
Louis H. Richardson.
Manual V. Sylvia, M.D.
Edwin E. Waite, M.D.

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Francis G. Curtis, M.D.
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W. F. Harbach.
Arthur Hudson.
Henry A. Stone.
E. R. Utley, M.D.

**New York City.**
Col. W. F. Morse.

**North Andover.**
Charles P. Morrill, M.D.

**North Brookfield.**
T. J. Garrigan, M.D.

**Norwood.**
Eben C. Norton, M.D.

**Pepperell.**
C. A. Dennen.

**Plymouth.**
W. G. Brown, M.D.

**Providence, R.I.**
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George W. McIntire.
Raymond L. Newcomb.
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Jesse Robbins, M.D.
William O. Safford.
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# Deerfoot Farm Milk

## IN GLASS JARS

OUR FAMILY MILK — coming from three great farms — is principally from Jerseys and their grades. The cows are daily exercised and fed generously with clover hay, corn fodder, and grain. Unlike the old-fashioned barn, where the manure is stored underneath and the hay overhead, the barns of Deerfoot Farm, Southboro, Mass., are well appointed and have ample ventilation, the feed being stored away from the cows, and the manure placed in a separate building a distance away.

It is under these conditions that our cows, with a good supply of pure water, carefully selected food, and good treatment, produce milk which has made Deerfoot Farm famous. Every day the apparatus at the dairy is not only boiled, but sterilized, to insure perfect cleanliness.

After being aërated and bottled, the milk is shipped from the dairy at 9 P.M., arriving in Boston at 2 A.M., and is delivered at **Back Bay, Brookline,** and **Cambridge residences** in our patent bottle, here illustrated, in time for breakfast.

No formalin, salicylic, or boracic acid used in any of the Deerfoot Farm Products.

## DEERFOOT FARM

**9 Bosworth Street, Boston**

**Telephone, 2289 Boston** **Send for Booklet Free**